

Appendix A Louisiana's Clusters

An Introduction to Cluster-Based Economic Development

Supporting the vision of Louisiana for 2020, Louisiana Economic Development has restructured its economic development efforts by implementing a cluster-based economic development strategy. What does this mean?

The most widely accepted definition of a cluster is “a geographically bounded concentration of similar, related, or complementary businesses with active channels for business transactions, communications, and dialog that share a specialized infrastructure, labor markets, and services, and that face common opportunities and threats.”

The key word in the definition above is one that delineates clusters from sectors, targets, or any number of other business terms: active. This word, active, is the primary defining factor in determining whether a region has a cluster or a sector. Sectors are also comprised of geographical concentrations of firms. The difference is in the social capital—the active channels among firms for sharing of business opportunities and innovations—that does or does not exist.

An industry-based economic development model, clusters are networks of compatible or competitive inter-related companies working together to strengthen the industry market. Clusters have trust and linkages among firms; facilitate specialization; and build critical mass. They create a commercial magnet that attracts customers, investment, skilled workers, and specialized infrastructure.

These businesses are invested in the success of a particular industry and will impact its growth and economic development through cooperative competition, or “co-opetition.” In cluster-based economic development, co-opetition occurs when competing companies work cooperatively for the greater good of their common industry.

A typical cluster includes a core industry or sector plus the related businesses, vendors, services, and resources that participate in the success of the industry. For example, Louisiana today has over 150 businesses involved in designing, building and repairing boats and ships, with a labor force of over 20,000 people (*Louisiana Manufacturer's Directory*). While these manufacturers form the core, many other firms support the industry. Metals suppliers/fabricators, transportation companies, the legal profession, educational institutions and others make up the “cluster” of organizations that support the primary operation of manufacturing a vessel. Cluster-based economic development is most successful when both current and future needs of the industry can be supported through building value added alliances within these organizations.



The key strategy of clustering as an economic development strategy is that it is industry driven. Louisiana Economic Development's Cluster Directors will facilitate linkages among industries in the state's targeted clusters, but the industries themselves must organize and support their clusters.

A study of the state's economy conducted in 2000 identified and characterized 15 existing and emerging clusters. The eight clusters of traditional industries included: oil, gas and energy technologies; petrochemicals; ship-building and other durable goods; tourism; transportation; health care; agriculture and food products; and wood, lumber, and paper.

Emerging clusters are those for which Louisiana has a small but growing base of firms and/or a strong university research base in a high growth industry. Emerging clusters can help diversify the state's economy. The seven emerging clusters identified include: information technologies, life sciences, environmental technologies, food technologies, advanced materials, micro- & nano-technologies, and entertainment.

In Louisiana, it is important to understand these basic concepts of cluster-based economic development in order to understand and embrace Louisiana's targeted clusters and the methods of developing them. While many of the identified industry concentrations Louisiana is focusing on could be strong sectors, perhaps only three or four today are true clusters that have developed these active channels. Following that, there may be several sectors with high concentrations of employment and revenue, but low levels of social capital.

Finally, there are a number of emerging, or targeted, technology areas that do not yet have concentrations, but do have a potential for high growth and evolution into true clusters. These areas are critical to the transformation of Louisiana's economy and should be given top priority. However, they do not meet the active channels criteria yet. By their nature, technology areas will take longer to produce results. Further, their potential in a technology-based economy to improve the effectiveness of Louisiana's existing clusters and sectors is enormous.

Cluster-based economic development focuses resources on creating conduits for physical, financial, and social capital that increase the effectiveness of firms within a regional economy. In the process, regions become more competitive and are able to grow and attract firms at a higher rate. The effectiveness of these efforts is measured not only in jobs and investment, but also active channels of communication and collaboration that are aided and increased by the economic development effort.

Cluster-based economic development follows a very simple principle: By improving the competitive position of similar and/or related companies within a region through effective social, physical, and monetary capital, an environment is created that will naturally attract other companies. In addition, in the process of improving the effectiveness of clusters, upstream (input) and downstream (output) gaps in the production process provide direct opportu-

nities for new company location. These new locations further diversify the cluster and provide new opportunities for synergy and collaboration. In short, a win-win-win situation is created, and economic development is no longer a zero sum game. As more value is added to resources, higher levels of investment occur, creating high wages and more wealth in the state.

For further information on Louisiana Economic Development, visit:
<http://www.led.state.la.us> or call 225-324-3000

Existing Clusters

Oil, Gas, and Energy Technologies

The oil, gas, and energy technologies cluster works to stimulate investment and jobs within the industries that explore, produce, and service the energy industry. The cluster has linkages to advanced materials, metals, and transportation industries, as well as increasing dependence on information and automation technologies to increase productivity and remain competitive.

In addition, the energy cluster works to enhance Louisiana's opportunities in developing alternative and renewable fuel technologies, further conservation technologies, and stimulate economic policies that positively impact statewide economic development. For over 100 years, Louisiana has been at the forefront of technological innovation in the energy business, and continues to be today. The energy industry, from extraction to production, is an engine of the state's economy. However, the volatility historically associated with energy markets also directly impacts the state's economy because of Louisiana's high economic dependence on oil and gas. Energy technologies provide us with a means to maximize the state's strong energy position, ensure future access to efficient, economic, and reliable energy sources that provide an environment conducive to economic development, and promote the development of less energy intensive industries. With this in mind, Louisiana must strive to diversify its sources of energy production while enhancing the extraction of our natural resources and the energy infrastructure to the benefit of the state as a whole.

Reliable, competitively priced and affordable energy is a strategic necessity for the state of Louisiana to maintain the dominant component of our existing economic base and to realistically expand and diversify the state's economy. Louisiana's economy is the 3rd highest energy dependent economy in the United States per capita.

Energy is the lifeblood of the Louisiana economy. Small ripples in the energy supply sector create large waves in Louisiana jobs, income, prosperity, and state government revenue. The future supply of energy should not be taken for granted. To ensure that resource, Louisiana must take strategic steps now to (a) facilitate maximum effective development of existing efficient and

reliable Louisiana energy resources, (b) promote development of alternative energy supplies, (c) develop and implement technologies to utilize energy much more efficiently, (d) establish policies that will ensure the development and maintenance of an energy production and transmission infrastructure that ensures a reliable, competitively-priced and affordable energy supply, and (e) diversify the state's economy into more industries that are less energy intensive.

Petrochemicals

The petrochemical cluster includes petroleum and chemical manufacturing companies and their support companies and is strongly tied to the energy cluster. Petroleum and chemical manufacturing companies are technology-intensive, vital to the U.S. economy, and critical to the competitiveness of other industries. Petroleum refining is critical to all other sectors, as it provides the energy for use in electric power plants, automobiles, chemical processes, and more. Similarly, many industries depend on the chemical industry, so it must continue to produce new, better products at prices that allow other U.S. users and producers of downstream products to compete in an increasingly global marketplace.

Louisiana is home to over 100 petrochemical manufacturers with over 300 manufacturing sites. The petrochemical industry directly employs over 30,000 workers, and more than 1,000 product and service companies identify themselves as having a substantial portion of their business in the petrochemical industry. The chemical and petroleum and coal products manufacturing sectors account for approximately 23 percent of manufacturing employment. Not only are large numbers of people employed within these sectors, these are high wage and salary jobs accounting for approximately 35 percent of the manufacturing payroll. As a result, Louisiana possesses the infrastructure and service providers necessary to be a successful manufacturer (*2000 County Business Patterns*).

Recognizing the aging population of the industry's operators, the state has partnered with industry to provide a dedicated petrochemical operations curriculum, known as PTEC, at a number of our Louisiana Technical College campuses. In conjunction with PTEC, Louisiana has opened three state-of-the-art "glass labs" at our campuses in Lake Charles, Reserve, and Baton Rouge that allow students to experience actual chemical processes in the classroom setting. These systems are complete with integrated process control systems and control room environments to realistically simulate the plant environment. In addition, trailers that are equipped to train maintenance and instrumentation plant workers can be taken to a plant site for in-house training of employees. The PTEC program provides an excellent model for a cluster that has been able to shape public curricula to meet their current and future business needs.

Shipbuilding and Other Durable Goods

■ Shipbuilding

Shipbuilding, which is the most concentrated of Louisiana's clusters, is truly a high tech existing cluster. The heavy concentration of ship and boat builders in Louisiana grew originally out of the abundance of waterways. The industry is also historically one of the most recognizable, considering that the Higgen's Boat used in the D-Day invasion at Normandy during World War II was an innovation developed in southeast Louisiana by a native shipbuilder.

Today, the shipbuilding industry is highly diversified, making all types of vessels. This includes, but is not limited to, ships for the armed services, recreational and pleasure crafts, luxury yachts, workboats, crew boats, tugs, and barges for the energy industry. Louisiana is home to the nation's largest commercial ship builder, and a Louisiana company was given the Ship of the Year 2002 award for a ship designed and built in Louisiana.

Approximately 20 percent of the nation's ship and boat building activity occurs in Louisiana, and the industry is growing. Most of these ship and boat builders are located in the south central part of the state from the New Orleans area west to around New Iberia. There are more than 20,000 individuals employed directly by approximately 150 ship and boat building and repair companies (*Louisiana Manufacturers Directory*). Most are small, with almost half employing less than 20 people and about 80 percent employing less than 100 people, although two of the nation's largest shipbuilders are also located in the state. Like the oil and gas and petrochemical companies, the shipbuilders are technology-intensive companies that require skilled and trainable workers.

The ship and boat building cluster has ties to a number of Louisiana's other clusters, including advanced materials for ship coatings, information technology products and services for ship design, machine tools for construction and instrumentation for the vessels, and environmental services companies, all of which provide support to the region's enterprises. In addition, many other companies provide products and services contributing to the construction efforts.

■ Aviation/Aerospace, Automotive, and Other Manufacturing

Manufacturing has long been one of the mainstays of Louisiana's economy. At least two additional durable goods sectors are emerging as important clusters in Louisiana -- aviation/aerospace and automotive. The durable goods market in Louisiana has been strong because of several factors: an exceptionally productive and well-trained workforce, the availability of resources, and a multimodal distribution system reaching across the country.

In order to boost durable goods manufacturing in Louisiana, the 2002 Special and Regular Legislative sessions created new and enhanced programs

to provide greater enticements for companies looking to expand or relocate to Louisiana. The Louisiana Quality Jobs program provides annual rebates for companies providing new full-time jobs, and the Louisiana Opportunity Fund provides a new financing tool to help develop public infrastructure for expanding or relocating companies. The state also extended the sunset date of the Enterprise Zone Tax Credit program that offers double the standard tax credits for certain automotive and airplane manufacturing activities. Other financial incentives provided additional funds for loan and venture capital programs and workforce training programs.

Tourism

Louisiana's tourism cluster includes businesses that provide products and services that support tourism in the state. Components of this cluster include but are not exclusive to restaurant services, hotel and accommodation services, recreation services, transportation services, shopping, visual/performing arts, and spectator sports. Louisiana's hospitality, along with its world-renowned food, unique culture, numerous fairs and festivals, fishing, beautiful scenery and architecture, as well as its many outdoor activities provide the ingredients necessary to make the tourism cluster successful.

Louisiana's 21.3 million visitors in 2001 meant an \$8.5 billion boost for the state's economy. The travel industry alone provides approximately 120,000 jobs to the state. The state has invested substantial dollars in marketing and advertising for the last several years, and this investment is beginning to pay off, with sustained growth in tourism in the state.

Although many of the jobs provided within this cluster are relatively low-skill, low paying jobs, the industry provides many jobs for Louisiana's relatively high population with lower education levels. While the state has instituted new K-12 and postsecondary education reforms, these changes take time to have an impact. Jobs for our relatively less educated population are critical, and the tourism industry provides many of those needed jobs.

Transportation & Logistics

The transportation & logistics cluster consists of industries that transport cargo and people via ground, rail, water, and air, as well as the support companies and infrastructure for these industries. Logistics is a boundary spanning activity playing a significant role in both traditional and fast growing industry clusters. In 2001, according to the recent Capital Region Competitive Strategy summary, U.S. freight transportation systems moved about \$9 trillion in cargo, approximately \$4 trillion of which was global expenditures.

Consider these facts about the Louisiana's transportation infrastructure. All of the Class 1 railroads in North America connect in Louisiana. Louisiana's public and commercial airports can accommodate the largest aircraft and are

home to some of the world's leading aerospace component manufacturers. Louisiana is home to five of the top fifteen ports in the United States, including three in the top ten. Louisiana's energy and petrochemical industry is connected by over 40,000 miles of pipelines. Because Louisiana is at the center of Western Hemisphere trade, the state plays a vital role in the transportation and distribution industry in North America and worldwide.

Furthermore, Louisiana's installed logistics infrastructure is among the most extensive in North America, including the largest complex of river ports in the world. Connected to the nation's agricultural and industrial heartland by extensive water, rail, and highway links, Louisiana is truly a world-class logistics hub.

Agriculture and Food Products

The agriculture and food products cluster remains an important part of Louisiana's economy. In 1999, agricultural commodities produced by the state's farmers, fisherman, foresters, and ranchers were valued at \$3.8 billion. With value added production of \$4.9 billion, agriculture's total contribution came to about \$8.7 billion. These commodities accounted for 44 percent of the value of Louisiana's exports in the first nine months of 2000, an increase of almost three percent over the same time period in the previous year. Processed food accounted for an additional 14 percent of total exports. Agricultural commodities form the basis of other existing and targeted sectors in Louisiana's economy, including wood products and paper, food processing, and food technologies. In addition, agriculture related research is producing biotechnology products and processes that can lead to improved crops, food safety, diagnostics, treatments, and more.

Wood, Lumber & Paper

The wood, lumber & paper cluster is concentrated in the north and central part of the state. It includes a variety of businesses among which are logging and timber companies, as well as companies involved with wood pulp and paper products. Wood product manufacturers, both primary and secondary, are also part of this cluster. Primary wood manufacturers include sawmills, lumber companies, and plywood companies, while secondary wood manufacturers include, cabinet and furniture manufacturers, as well as companies involved with pallets/skids and millwork. It is these secondary wood products manufacturers that generate the greatest value added for the state, so it is where economic development efforts will be concentrated.

According to the *2000 County Business Patterns*, the wood products and paper industry provides over 19,000 jobs accounting for approximately 12 percent of manufacturing employment.

The paper manufacturing sector alone accounts for seven percent of manufacturing employment and eight percent of total payroll. At the

same time, this industry accounts for only two percent of manufacturing establishments, meaning a relatively small number of establishments employ relatively large numbers of people. Forty-four percent of establishments have more than 100 employees and only 18 percent have less than 20 employees. As a result, if one employer leaves or shuts down, its impact would have significant aftershocks.

Healthcare

The healthcare cluster includes businesses that provide healthcare products and services including but not exclusive to hospitals, doctor's offices, pharmacies, nursing homes, home health agencies, medical testing laboratories, and many more. Established healthcare providers as well as new specialty services are a part of this cluster.

Nationally, the healthcare industry is growing rapidly and is critical to the well being of our state's citizens, making this cluster's success vital for the state of Louisiana. According to *Hospitals and the Louisiana Economy*, Louisiana's healthcare industry provides approximately 203,642 jobs resulting in a total state payroll of \$5.7 billion, 14 percent of Louisiana's total payroll.

A major challenge for Louisiana's healthcare industry is the lack of skilled workers. There will need to be an increase in the number of healthcare personnel in the state in order to keep up with the needs of healthcare providers and suppliers.

Emerging Clusters

Life Sciences

The life sciences cluster includes companies that provide products and services related to human health, including pharmaceutical, nutrition, gene therapy, as well as medical devices and instruments. Much of the activity in recent years has been centered in the area of biotechnology.

Biotechnology is the application of engineering principles to the life sciences. Both new and established companies are designing, creating, and producing new substances that are derived from naturally occurring molecular structures and processes. Biotechnology is constituted in part by new capabilities in gene cloning and fusion (genetic engineering); in understanding and facilitating selective biochemical reactions outside their native organisms, including protein engineering, which is leading to more potent drugs often through rational drug design; and in controlled fermentation, preservation and chemical conversions for product enhancement (chemurgy). Biotechnology has required the integration of biochemistry, microbiology, applied plant and animal physiology, pharmacology (and accompanying clinical-type skills), agronomy, animal husbandry, food science and chemical engineering.

Louisiana has in place the elements necessary for a strong supporting infrastructure for medical and biomedical activities. Extensive research is being conducted in a wide variety of fields at the Pennington Biomedical Research Center, the Louisiana Gene Therapy Research Consortium, the Biomedical Research Foundation of Northwest Louisiana, the Louisiana Cancer Research Center, the LSU medical centers in New Orleans and Shreveport, the Tulane Medical Center, the Biomedical Engineering Department and Institute for Micromanufacturing at Louisiana Tech, the School of Pharmacy at the University of Louisiana at Monroe, the College of Pharmacy at Xavier University, UNO's National Biodynamics Laboratory, the LSU School of Veterinary Medicine, the Center for Advanced Microstructures and Devices (CAMD) at LSU, and the primate centers associated with UL and Tulane. In addition, the state has funded research and infrastructure to foster and capture opportunities in the biosciences, such as building three 60,000 square foot wet lab business incubators around the state and funding the research-focused Governor's Bioscience Initiative.

This research base along with strong technology management programs at these universities and research facilities can facilitate the creation and growth of medical and biomedical technology-based companies in Louisiana. Furthermore, these facilities are training students for careers in these companies.

Information Technologies

Perhaps more than any other technical area, information and communication technologies are the basis for today's new economy. The ability to rapidly access and share vast amounts of information was the driving force in economic growth and improved quality of life in the latter part of the 20th Century and now the beginning of the 21st Century. Accordingly, information and communication technologies are essential for economic growth and for helping other technical areas to realize their full potential. This emerging technology area has specific fields of expertise:

- Software
- Automation
- Telecommunications & Internet

■ Software

Computer software is one of the few key technologies that daily affect almost every aspect of our lives. The instructions embodied in software run telephone switching systems; make our automobile transmissions shift smoothly by reacting to dozens of sampled factors many times a second; encode and route electronic fund transfers among the nation's and the world's banks; provide the displays and communications vital to our air traffic control system and the control systems of individual planes; guide machine tools in forming complex parts; and run hundreds of thousands of other applications,

including such routine but vital business functions as word processing, spreadsheets, and email.

Although Louisiana is not known as a center of software development, Louisiana companies and entrepreneurs have developed and are marketing new software every day. This software is designed to address needs in a wide variety of fields and is often targeted to niche markets. The industry is growing in part due to the significant opportunities afforded by large federal and state software development initiatives. In some cases, local graduates or native Louisianians looking to create jobs for themselves have developed new software so they can stay in or return to Louisiana.

■ Automation

Among the most important factors contributing to the rebound and growth of the manufacturing sector in the United States over the past 20 years has been the integration of computers into production processes at all levels. Their use has greatly improved the potential for and the efficiencies in:

a) capturing, storing, and processing hierarchical data; b) interpreting sensory measurements; c) analyzing and controlling large, complex systems; and d) communicating information more rapidly. Computer aided design (CAD) and computer aided manufacturing (CAM) are ubiquitous as are micro-processor controlled machine tools, material handling equipment, robots and continuous process controllers. The result has been a resurgence of American manufacturing prowess that cost-effectively and consistently reduces goods that are of uniformly high quality and thus, sought after in a competitive global marketplace.

Louisiana's participation in this resurgence has been largely (and predictably) focused in the bulk chemical manufacturing and petroleum exploration and refining sectors. Notwithstanding this focused experience, there are opportunities to expand the use of these technologies to other industrial sectors within the state. Moreover, because of this experience, there are even greater opportunities to develop and exploit advanced manufacturing concepts in the following areas: computer integrated manufacturing (CIM), equipment interoperability, intelligent processing equipment, and predictive process control. Underlying these concepts is the concurrent need to develop improved systems hardware and software, adaptive machine tooling and processing equipment, advanced sensors, and the instrumentation necessary to monitor and maintain each.

■ Telecommunications & Internet

Telecommunications and Internet technologies are tremendous growth areas that include software as well as hardware technologies. Internet-related

technology development is moving forward on many fronts, from improvements in electronic commerce, routing, management of the large amounts of information being moved, and voice communication to innovative ways to use the Internet. In the area of telecommunications, continued growth is pro-

jected in wireless technologies both for voice and data transmissions. New satellite systems and high-altitude platforms are interconnected with optical fiber systems and terrestrial wireless networks to provide voice and data access whenever and wherever they are needed. Telecommunications and Internet technology areas offer opportunities in fast-growing markets that are critical to the future of our nation and state.

A number of research efforts in these areas are underway at Louisiana universities. For example, research at the University of Louisiana's Center for Advanced Computer Studies (CACs) focuses on automated reasoning, computer vision and pattern recognition, parallel computing, wireless and mobile computing systems, intelligent robotic systems, and Very Large Scale Integration (VLSI). The NASA Regional Application Center, which is housed in CACS, is one of four initial sites in the United State collaborating with NASA in the Mission to Planet Earth and Earth Observation System program for collecting and processing massive amounts of data transmitted by current and future satellites.

Environmental Technologies

The Clean Air Act of 1970 and the Comprehensive Environment Response, Compensation, and Liability Act of 1980 (CERCLA or Superfund) precipitated massive efforts to reverse precedent damage to the environment caused by detrimental industrial and municipal waste disposal practices. With regard only to hazardous waste sites currently listed by the Environmental Protection Agency (EPA) for example, clean up costs through the year 2020, using existing remediation practices, have been projected to approach \$1 trillion. Predictably, in the wake of these environmental initiatives, the demand for environmental technologies has grown.

The environmental cluster includes companies that provide products and services, including consulting services, to companies and governments within and outside of Louisiana. The state is home to innovative companies that are dedicated to manufacturing with the highest standards of environmental stewardship. Our strong manufacturing base has attracted and grown the technical expertise, i.e., chemical, biological, geological, mechanical, and civil engineering, required to effectively implement its environmental initiatives.

There are also strong academic and research programs at the state's post-secondary educational institutions that support the state's efforts. Researchers at LSU have developed novel microorganisms for the biodegradation of toxic wastes and methods for the electrochemical decontamination of soils and slurries. At Louisiana Tech, researchers are investigating the development of environmentally safe pesticides and have patented microbial agents and biological herbicides to control weeds in lawns, turf grass and row crops as well as blue-green algae to improve water quality in aquatic environments.

Likewise, there are a number of firms in Louisiana, large and small, currently engaged in environmental remediation work. For these reasons, Louisiana is well positioned to actively participate in the global market for environmental technologies. This market is growing and maturing, and there remain significant opportunities to advance the state-of-the-art in each of its segments: monitoring, characterization, containment and remediation.

Advanced Materials

The advanced materials cluster includes companies engaged in the development and/or manufacturing of specialized products, such as coatings, adhesives, catalysts, composites, biocompatible materials, and electronic materials. These products are designed to solve problems, lower costs, improve durability, or minimize environmental damage. While most of these materials are developed for a particular use, they are often adaptable to other applications or other market segments.

Advanced materials is an enabling technology industry; one that complements and adds value to existing industries. In Louisiana, advanced materials companies are providing products for the petrochemical, oil and gas production, shipbuilding, wood products, and paper industries. They provide products such as specialized coatings (paints) for ships, oil and gas pipelines, and pipelines and structures in petrochemical plants, as well as adhesives for the wood products and paper industries.

Advanced materials are often a downstream application of the petrochemical sector. Companies in these fields may also be a part of the environmental sector, supply coatings for oil and gas production applications, provide advances used in the biotech/biomedical sector, or may be developed for micro-manufacturing applications. They can also contribute to food technologies.

Because Louisiana recognizes the importance of research and education in the advanced materials industry, the state has placed great focus on the development of a strong academic infrastructure for research and development. To date, Louisiana has also invested \$18 million in the National Center for Advanced Manufacturing (NCAM). Located in the Michoud Space Center, NCAM provides a sophisticated carbon fiber placement unit that is operated by three public and private partners: NASA, Lockheed Martin, and the UNO. As the shuttle program matures, Lockheed Martin and UNO will pursue new cutting-edge research based on carbon fiber materials, in the anticipation of future investment and job expansion in this niche. Classroom facilities are located onsite providing training for today and tomorrow.

Food Technologies

The food technologies cluster includes companies involved in the production and processing of food. In addition to Louisiana's food processing companies, the state has important advantages in critical, growing technology areas related to safety and to the continuing need for food throughout the world.

The *National Critical Technologies Report* (The White House, Office of Science and Technology Policy) lists three areas under Agriculture and Food Technologies as technologies that are critical for maintaining the strength and competitiveness of the United States: sustainable agricultural production, food safety assurance, and aquaculture and fisheries. Louisiana has important assets in each of these areas.

Global agriculture is facing the challenges of an increasing human population, an accelerating need for food, fiber, feed and raw materials for other industries, and a declining amount of cultivated land per capita. Sustainable agricultural systems must address the development of environmentally sound, productive, economically viable and socially desirable agriculture.

Ensuring food safety to the best extent possible is an ongoing challenge because the route from field or catch to table is a long one with many handlers involved in processing, storage and transportation. No technology for processing food is universally protective, but efforts to increase the level of protection are made through food safety technologies including technologies to monitor food quality and detect bacteria, viruses, parasites, and/or chemical contaminants at the processing plant.

The increase in food poisoning from bacteria, viruses and parasites is escalating in almost every country that collects statistics on the subject. Attempts to halt these trends in food poisoning occurrences have focused on the re-establishment of surveillance systems and attempting to require new testing and standards on the food industry.

The Southern Regional Research Center (SRRC), a U.S. Department of Agriculture (USDA) lab in New Orleans, is heavily involved in R&D related to food technologies. The Food and Feed Safety research unit focuses on characterization of factors that contribute to food contamination and development of methods to detoxify these contaminants; developing methods to increase resistance to crop infections and reduce contamination of preharvest crops.

Aquaculture is a rapidly growing agriculture segment that will play a significant role in providing a stable source of fish protein in the face of declining yield of oceanic fisheries. Aquaculture and fishery technologies make a significant contribution to the U.S. food supply. They also make a positive contribution to job creation and economic growth, and to the U.S. balance of payments by reducing dependence on imported seafood and increasing U.S. exports of fish and shellfish. Louisiana's aquaculture crops play a significant role in contributing to this food supply with its estimated farm value of \$123 million.

Although food technology firms are small in Louisiana, food processing is important in the state and there is a large research base at Louisiana universities, including the LSU AgCenter and its extension offices and research centers around the state, the Crawfish Research Center at ULL, LSU's Sea Grant Program, and USDA's Southern Regional Research Center in New Orleans (a federal lab focused largely on food technologies) that can provide support for the companies as well as develop technologies for transfer to the private sector.

Micro- & Nano-Technologies

Micro- and nano-technology is simply the science of small things. This field includes the design, fabrication, integration, and validation of devices that utilize the benefits of engineered micro- and nano-scopic features. Micro refers to structures that range in size from 100 micrometers (diameter of the human hair) to 1 micrometer (diameter of blood cells), while nano spans the size range of blood cells down to the atomic level (.5 nanometer is the diameter of an atom).

Microstructures are being used and required increasingly as smaller devices with increased functionality are demanded. Their primary use today is as sensors in car airbag deployment systems and in nozzles of ink jet printers; however, researchers throughout the world are developing tiny motors, valves, RF devices, heat exchangers, computer memory chips, turbines, and pumps. In addition very important uses will be developed in the medical, diagnostic tool, and surgical instrument industry.

Around the state a number of groups are developing advanced micromachining technology, which can be used to create a wide range of new products. These manufacturing technologies are enabling micro- and nano-technology to move from the research lab into the showroom. The new manufacturing techniques are leading to the miniaturization of products, which opens new markets and/or maintains competitive products through cost reduction, improved reliability and increased functionality.

Micro- and nano-devices, are now regarded as critical technologies in fields such as the aerospace, automotive, biomedical and communications industries. Future commercial applications include microfluidic manipulators for implantable drug dispensers, navigation gyroscopes for aerospace use and magnetic and optical storage, switching devices, and displays for information technology. According to one estimate, the microelectromechanical systems (MEMS) market is predicted to grow from an estimated \$2 to \$5 billion in 2000 to \$8-\$15 billion by the year 2004 (*Small Times*, Jan. 21, 2002).

Louisiana has the potential to be at the forefront of development of these technologies. At the beginning of the 1990s, Louisiana established strong microfabrication and materials research centers across the state, namely the Institute for Micromanufacturing (IfM) at Louisiana Tech University, the Center of Advanced Microstructures and Devices (CAMD) at LSU, and the Advanced Materials Research Institute (AMRI) at UNO. These focused efforts are supported by research teams at the associated universities addressing subjects ranging from basic research to the education of the next generation workforce for industry.

Lately, additional complementary efforts have been initiated at Louisiana's medical schools to adopt these technologies in their research efforts and use them to create new tools. Furthermore, the first spin-off companies have been founded and are focused on commercializing a variety of micro- and nano-enabled systems.

All these efforts are being supported by statewide initiatives to strengthen collaborations among the groups. They are also working to attract new businesses to the state to build upon this new high-tech industry. The results of microfabrication research and development will also have significant impact on many of Louisiana's other existing and emerging clusters, such as biotechnology, oil and gas, advanced materials, and even in the automotive manufacturing sector.

Entertainment

The entertainment cluster consists of businesses and infrastructure associated with the music, film, and video industries. It also includes other related industries such as sports (Hornets, Saints, and racing) and live entertainment. The state is focusing its resources on developing and improving the infrastructure needed to support the entertainment industry. Examples include working with banks to familiarize them with the industry, setting up funds to support the film industry, and working with significant law firms in the state to help them develop entertainment practices.

For Louisiana to diversify its economy, the entertainment industry is proving to be an important area of growth. The state's large amounts of production and music talent, along with an award-winning tourism industry, make the state a likely candidate for the success of an entertainment cluster. Leaders of this cluster are continuing to travel around the state surveying the vast wealth of talent located here and defining the issues that need to be addressed to ensure that an infrastructure is in place to make the entertainment industry a thriving cluster in Louisiana.

During the 2002 special session of the legislature, the state showed its commitment to the film and television industry by passing three pieces of legislation providing incentives for productions in Louisiana. The result of these incentives is an increase in production in the state from \$30 million in the year prior to the incentives to more than \$140 million in production completed, now shooting, or with commitments to begin shooting in the near future. The increased amounts of work coming to Louisiana have pushed the state to address some missing infrastructure components, including job training for these high paying jobs that do not necessarily require a college degree.

In addition to the incentives for the movie and television industries, New Orleans has eliminated the live performance tax on music, opening up even more opportunities for growth of its vibrant music sector.